

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Stephan Kirchmeyer et al.

Application No.: 10/627,162

Confirmation No.: 2513

Filed: July 25, 2003

Art Unit: 1714

For: AQUEOUS DISPERSION CONTAINING A
COMPLEX OF POLY(3,4-
DIALKOXYTHIOPHENE) AND A
POLYANION AND METHOD FOR
PRODUCING THE SAME

Examiner: V. M. Ronesi

REPLY BRIEF

MS Reply Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

In response to the Examiner's Answer mailed November 18, 2009, the applicants submit the following Reply Brief.

The applicant believes that the Examiner has made the following misstatement in the Examiner's Answer.

1. In response to section 9 of the Examiner's Answer: Grounds of Rejection

The Examiner rejects claims 7-24, 27 and 28 under 35 U.S.C. 103(a) as being unpatentable over Jonas (US 5,300,575) in view of Moehwald (US 4,728,399).

The object of the present application was to provide a conductive polymer having excellent transparency and conductivity (see page 3, lines 6-11). This object is achieved by the methods for producing an aqueous dispersion described in the claims, whereby a 3,4-

dialkoxythiophene is polymerized in the presence of a polystyrene sulfonic acid polyanion, using peroxodisulfuric acid as oxidizing agent and with a pH during polymerization of 1.5 or less. It is shown in Tables 1 and 2 of the present application that a particularly good combination of transparency and conductivity is achieved. It can be determined from Table I that the inventive Examples achieve lower resistivity (and thus higher conductivity) and higher total light transmission compared to the Comparative Example. The advantage of the inventive Examples compared to the Comparative Example is also evident in Table 2, which shows the surface resistivity at total light transmission of 80% of the inventive Examples to be considerably better than that of Comparative Example 3.

The Examiner correctly stated at the bottom of page 3, starting at line 14 of the Examiner's Answer, that Jonas discloses a polymerization of 3,4-dialkoxythiophenes wherein 3,4-dialkoxythiophene, a polyacid (= polyanion — Jonas, col. 2, lines 45-61) and an oxidizing agent can be dissolved in water and stirred at the polymerization temperature until the polymerization reaction is complete (Jonas, col. 2, line 12 — col. 3, line 25). As the Examiner correctly stated at page 4, lines 3-4 of the Examiner's Answer, Jonas fails to disclose (1) peroxodisulfuric acid as a possible oxidizing agent, and (2) the pH of 1.5 or less during polymerization.

The Examiner stated at page 3, the last paragraph, starting at line 14 of the Examiner's Answer,

“Jonas discloses ... and strong inorganic acids to increase the polymerization rate (col. 4, lines 22-26)...

It is recognized that Jonas does mention the possibility, in formulations where **weakly acidic** polyacids (polyanions) such as the polyacrylic acids are used, of adding strong monoacids, such as hydrochloric acid, sulphuric acid or aromatic sulfonic acids, to the polyacids

to increase the polymerization rate (Jonas, col. 4, lines. 22-26). However, Jonas does not teach or even suggest using a strong monoacid under any other circumstances, i.e. other than when a weakly acidic polyacid is used as polyanion. Thus, Jonas teaches to the person of ordinary skill in the art to add a strong monoacid only to a formulation with a weakly acidic polyacid such as polyacrylic acid, and not to a formulation having, for example, polystyrene sulfonic acid as polyanion. Since Jonas also does not teach the use of peroxodisulfuric acid, or indeed of any other acid, as oxidizing agent, Jonas thus neither teaches nor suggests a combination whereby a 3,4-alkylenedioxythiophene or a 3,4-alkyldioxythiophene and a polystyrene sulfonic acid as polyanion are polymerized at a pH of 1.5 or less. Jonas thus does not disclose or even point towards the presently claimed subject matter.

Furthermore, Jonas teaches that adding a strong monoacid has the effect of increasing the polymerization rate. The person of ordinary skill in the art knows that increasing polymerization rate can lead to reduced selectivity and undesired side reactions, such as increased branching or shorter chain lengths in the resulting polymer. Increased branching and shorter chain lengths in a conducting polymer are known by the person of ordinary skill in the art to result in shorter conjugation lengths and thus reduced conductivity. Thus, where higher conductivity is desired, the person of ordinary skill in the art reading Jonas would avoid the use of strong monoacids since according to Jonas they increase polymerization rate and thus are expected to result in lower conductivity of the resulting polymer.

In fact, Jonas teaches away from adding acids in general. In col. 3, lines 63-65 Jonas clearly teaches that non-corrosive oxidizing agents are preferred:

“The use of the per sulfates and the iron (III) salts of organic acids and inorganic acids containing organic residues has the major applicational advantage that they are not corrosive.”

The person of ordinary skill in the art knows that acids are generally more corrosive than their corresponding metal salts, so that for this reason alone Jonas teaches away from using peroxodisulfuric acid as oxidizing agent. Furthermore, Jonas mentions that oxidizing agents typically used for the oxidative polymerization of pyrrole can be used (Jonas, col. 3, lines 11-12), but specifically does not mention as oxidizing agent peroxodisulfuric acid or indeed any acid, but only acid salts (Jonas, col. 3, lines 48-65), even though according to the Examiner peroxodisulfuric acid was a particularly useful oxidizing agent in pyrrole polymerizations (see page 4, third full paragraph of the Examiner's Answer). Jonas thus also teaches away from using acids as oxidizing agent, including peroxodisulfuric acid, for this reason.

Jonas thus teaches away from the use of acids as oxidizing agent, and also from a low polymerization reaction pH in general. In addition, while it is stated that the polymer films obtained in the Examples of Jonas are transparent, the surface resistivities of Jonas' examples are several orders of magnitude higher than those achieved in the present application, so that the present application represents a significant improvement over the teaching of Jonas.

The teaching of Moehwald is of the *in situ* preparation of layers of electrically conductive polymers. The Moehwald method is to apply a preferably aqueous solution of a monomer and a conductive salt to a metal surface and subsequently to treat the thus-applied solution with an oxygen-containing oxidizing agent (Moehwald, claim 1 and col. 2, line 66 — col. 3, line 2), Moehwald therefore does not disclose a method for preparation of an aqueous dispersion as described in the claims of the present application.

Furthermore, the monomer is selected from *inter alia* pyrroles, thiophenes and furans, whereby preferred among the thiophenes are unsubstituted thiophene, 2- or 3-alkylthiophenes such as 2,3-diethylthiophene (Moehwald, col. 2, lines 14-36). Moehwald thus does not disclose a 3,4-alkylenedioxythiophene or a 3,4-dialkyldioxythiophene according to formula (1) of the

present application. Moehwald also does not disclose polystyrene sulfonic acid as polyanion. Accordingly, Moehwald not only fails to disclose the method for preparing an aqueous dispersion as presently claimed, it also does not disclose an aqueous dispersion containing a poly(3,4-alkylenedioxythiophene) or a poly(3,4-alkyldioxythiophene) and a polyanion as claimed in the present application.

The oxidizing agent of Moehwald can be peroxyacids and their salts, such as *inter alia* peroxodisulfuric acid and its salts. The salts are preferred in Moehwald, as is disclosed in the list in col. 3, lines 3-12 of Moehwald and from the use of sodium persulfate in Example 1.

The disclosure of Moehwald with respect to peroxodisulfuric acid is thus that this acid is one of a number of oxidizing agents which can be used as oxidizing agent for *in situ* polymerization of the monomers listed therein, which are not the same as the monomers of either Jonas or the present application. There is no teaching in Moehwald of peroxodisulfuric acid being suitable for solution polymerization as used in both Jonas and the present application. In addition, Moehwald is silent regarding conductivity and transparency of the polymer film.

The Examiner's statement at the bottom page 4 of the Reply Brief, "*the process taught by Jonas and Moehwald intrinsically has polymerization occur at a pH of 1.5 or less since peroxodisulfuric acid is present*" is, with all due respect, incorrect. Neither Jonas nor Moehwald provides an example where the use of an acid as oxidizing agent is reduced to practice. In addition, as already pointed out above, Jonas does not teach the use of any acid as oxidizing agent, and the use of strong monoacids only in combination with weakly acidic polyacids, so that a pH of 1.5 or less could not be achieved in other combinations of thiophenes with polyanions, such as those presently claimed. Furthermore, since the oxidizing agent in Moehwald is applied as a separate layer onto a previously applied layer of the monomer solution, the pH of this layer

cannot be considered, since pH is a solution phenomenon. It is thus submitted that neither Jonas nor Moehwald, alone or in combination, discloses intrinsically a pH of 1.5.

Accordingly, for all the above reasons, the person of ordinary skill in the art could not combine the teaching of Jonas with that of Moehwald to arrive at the present invention.

Furthermore, the person of ordinary skill in the art reading Jonas would have no incentive to combine the teaching of Jonas with that of Moehwald in order to arrive at the present invention.

Neither Jonas nor Moehwald teaches or even suggests that a reaction solution pH of 1.5 or lower might result in advantageous properties of the resulting polymers. As discussed above, Jonas actually teaches away from the general use of acid. The person of ordinary skill in the art would therefore not consider using the peroxodisulfuric acid of Moehwald in the invention of Jonas. In addition, the methods and processes of Jonas and Moehwald are so different from each other that the person of ordinary skill in the art would not consider that the teaching of one would be transferable to the other.

Applicant thus respectfully submits that the presently claimed invention is not obvious over Jonas in view of Moehwald.

2. In response to section 10 of the Examiner's Answer: Response to Argument

The Examiner raises several issues in this section:

Firstly, the issue concerning the failure of Jonas and Moehwald to disclose or suggest that polymerizing at pH of 1.5 or less provides for improved transparency and increased conductivity:

With all due respect, the Examiner's point cannot be followed. The Applicant was pointing out that the advantages of the present invention are neither disclosed in, nor can be derived from, the teaching of Jonas or Moehwald, alone or in combination with each other. As

noted above, the conductivities resulting from the present invention represent a significant improvement over Jonas (compare Table 1 of the application versus the examples of Jonas). No data is provided in Moehwald for comparison, and in any case, as mentioned above, Moehwald teaches a different method and different polymers, making a direct comparison of the polymer films irrelevant.

Applicant further believes that the statement of the Examiner in the middle of page 5 of the Examiner's Answer starting at line 10,

"First, there is no requirement that a person of ordinary skill in the art would have recognized the property at the time of the invention but only that the subject matter is present in the prior art reference"

is not entirely correct. The applicant believes that it is incorrect to simply combine features from different documents in order to arrive at the combination of features of a claimed invention, when the prior art documents do not contain any indication or incentive to combine these elements, as in the present case. This results in a hindsight analysis. Furthermore, it is not permissible to simply pick and choose only so much of a prior art reference as will support a given position, excluding other parts necessary for a full consideration of the teaching of the reference by the skilled person. Accordingly, the entire teaching of a prior art document must be considered. As discussed above regarding the art, neither the entire teaching of Jonas nor the entire teaching of Moehwald was considered. Applicant thus respectfully submits that the Examiner has based the rejection and the comments here on an incomplete reading of the prior art and on a hindsight analysis.

Furthermore, the Examiner actually appears to be basing the response here not on Jonas and Moehwald but on the differences between the inventive examples and the comparative example. In this respect, it is reiterated that the combination of transparency and conductivity is

improved in the inventive examples compared to Comparative Example 3, where no peroxodisulfuric acid was used and the pH was above 1.5 (see Tables 1 and 2 of the application).

Secondly, the Examiner's comments in the fourth paragraph at page 5, starting on line 15 of the Examiner's Answer

"Appellant argues that polymerizing at a pH of 1.5 or less unexpectedly provides for improved transparency and increased conductivity".

With regard to the objection regarding differences in transparency, it is reiterated that an advantageous combination of transparency and conductivity is achieved, as shown in Tables 1 and 2. It is this combination of properties which is desired and which makes the end products particularly suitable for their end applications.

The Examiner at the bottom of page 5, starting at line 19 of the Examiner's Answer considers that Examples 13 and 15-18 and Comparative Example 3 are not side-by-side examples because the water dispersions of complex on which they are based are not directly comparable, since the type of oxidizing agent is different. This is one of the differences of the present invention compared to the prior art disclosures, so that these Examples provide a comparison with the prior art.

The Examiner also argues in the paragraph at page 6, starting at line 9 of the Examiner's Answer that Examples 13 and 15-17 are not proper side-by-side examples because the amount of peroxodisulfuric acid in Example 1 (basis dispersion for Example 13) is less than in Examples 3-4 (Examples 15, 16). These Examples also have a pH of less than 1.5 and according to the Examiner in the same paragraph of the Examiner's Answer, are not a proper comparison to independent claims 7 and 9 which do not include an additional acid. According to the Examiner it is not clear if the increase in conductivity is due to the acid or due to decreased pH.

The applicant can not follow these arguments. Examples 13 and 15 to 17 are inventive Examples, so that no comparison with each other is necessary for determining patentability. Example 13 uses peroxodisulfuric acid without additional (other) acid and thus exemplifies claims 7 and 9. Examples 15 to 17 include a further acid and thus exemplify claims 8 and 10 (see Table 2 at page 19 of the specification). It is not necessary in a patent application to provide an exhaustive array of Examples and Comparative Examples covering every possible combination of features, provided that the scope of the claims is commensurate with the disclosure and teaching in the description and Examples. Applicant respectfully submits that this is the case for the present application. The claims have already been amended in the proceedings in order to take account of the Examiner's recommendations in this respect. Applicant also submits that it is irrelevant for the disclosure of the present application whether the increase in conductivity is due to the acid or due to decreased pH. The addition of the acid in the claimed method reduces the pH of the reaction mixture at the time of polymerization. The reaction mixture pH is an easily measurable feature which clearly defines and delimits the claimed scope of protection, so that the person of ordinary skill in the art knows exactly whether he is working within or outside the scope of the claims. For the reasons set forth above, Applicants believe that the claims are patentable over the references cited and applied by the Examiner.

A prompt and favorable action is solicited.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 03-2775, under Order No. 13077-00158-US from which the undersigned is authorized to draw.

Dated: January 18, 2010

Respectfully submitted,

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